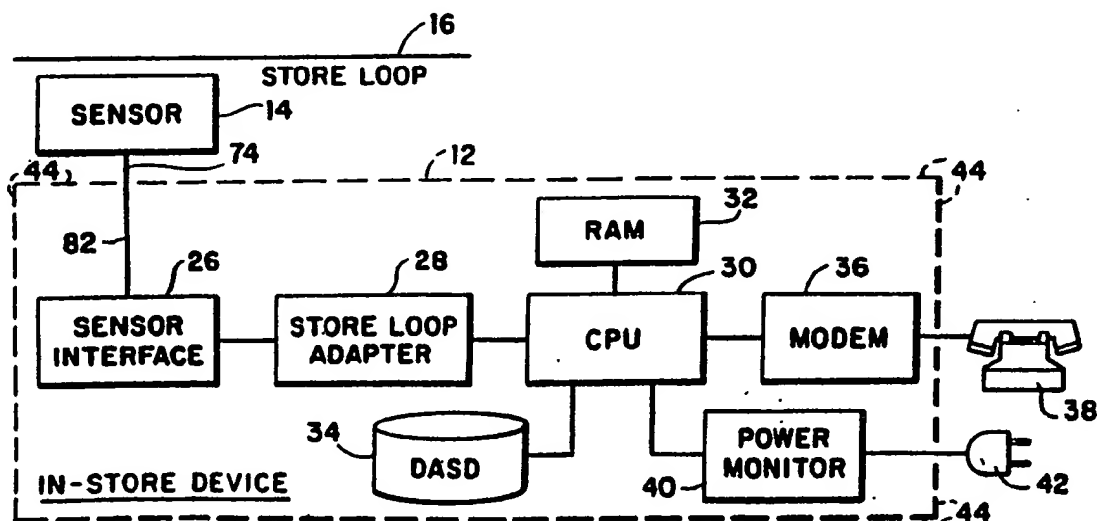




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁴ : H04B 17/00		A1	(11) International Publication Number: WO 89/ 07868
			(43) International Publication Date: 24 August 1989 (24.08.89)
(21) International Application Number: PCT/US89/00385		(74) Agent: MASON, KOLEHMAINEN, RATHBURN & WYSS; 20 North Wacker Drive, Chicago, IL 60606-3184 (US).	
(22) International Filing Date: 31 January 1989 (31.01.89)			
(31) Priority Application Number: 155,052		(81) Designated States: AT (European patent), AU, BE (European patent), BR, CH (European patent), DE (European patent), FR (European patent), GB (European patent), IT (European patent), JP, LU (European patent), NL (European patent), SE (European patent).	
(32) Priority Date: 11 February 1988 (11.02.88)			
(33) Priority Country: US			
(71) Applicant: A.C. NIELSEN COMPANY [US/US]; Nielsen Plaza, Northbrook, IL 60062 (US).		Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	
(72) Inventors: DANIEL, James, N., Jr. ; 270 Thackeray Lane, Northfield, IL 60093 (US). BUSYN, Thomas, F. ; 1466 Lake Avenue, Wilmette, IL 60091 (US). BAT-TERMAN, Brent, T. ; 36043 N. Grand Oaks Court, Gurney, IL 60031 (US).			
BEST AVAILABLE COPY			

(54) Title: MARKETING RESEARCH SYSTEM FOR OBTAINING RETAIL DATA



(57) Abstract

A market research retail sales data collection system and method includes a plurality of cooperating retail stores, each having an in-store device (12) for automatically collecting, processing and storing market research data in a substantially totally passive or non-invasive manner with respect to the on-going operations of each retail store. Each in-store device includes a non-invasive store loop sensor assembly (14), a sensor interface (26), a store loop communications adapter (28), a central processing unit (30), a random access memory (32), a processed data storage device (34), a power monitor (40) and a communications modem (36) for connecting the in-store device through a communications network to a central site (24) for subsequent use by market researchers. Each in-store device continuously monitors, detects, interprets, processes and stores retail sales transactions data from its retail store for subsequent periodical transmission to the central site.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	FR	France	ML	Mali
AU	Australia	GA	Gabon	MR	Mauritania
BB	Barbados	GB	United Kingdom	MW	Malawi
BE	Belgium	HU	Hungary	NL	Netherlands
BG	Bulgaria	IT	Italy	NO	Norway
BJ	Benin	JP	Japan	RO	Romania
BR	Brazil	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic	KR	Republic of Korea	SE	Sweden
CG	Congo	LI	Liechtenstein	SN	Senegal
CH	Switzerland	LK	Sri Lanka	SU	Soviet Union
CM	Cameroon	LU	Luxembourg	TD	Chad
DE	Germany, Federal Republic of	MC	Monaco	TG	Togo
DK	Denmark	MG	Madagascar	US	United States of America
FI	Finland				

Marketing Research System For Obtaining Retail Data

BACKGROUND OF THE INVENTION

A. Field of the Invention

5 The present invention generally relates to systems and methods for the collection of market research data from a plurality of cooperating retail stores each of which utilizes Point-Of-Sale (POS) optical scanners/registers and associated automatic
10 controllers. More particularly, the present invention concerns a substantially totally passive or non-invasive automated system and method for collecting market research data on a real-time basis from a plurality of cooperating retail stores.

15 B. Description of the Prior Art

 The collection, summarization and forwarding of Point-Of-Sale purchasing information from retail stores for purposes of market research are old and well-known, particularly since the advent of Point-
20 Of-Sale (POS) optical scanners and the widespread use of the Universal Product Code (UPC) to identify retail products. Typically, retail purchase data is summarized by an in-store POS controller or by a separate store computer attached to the POS controller in the
25 store or, if the store is part of a large retail store chain, by a central or host computer at the headquarters of the retail store chain. The summarized retail

-2-

purchase data is then typically forwarded to the users of the data by any one of a number of different data storage and transmission techniques, for example, by magnetic tape or disk or diskette or by telephonic
 5 data transmission or by over-the-air data transmission.

Very often the market research purpose for the collection of such data is secondary to the primary purpose of assisting retail store operators and managers in product pricing and inventory control. Therefore, often the data collected and summarized does
 10 not meet the needs of market researchers.

The following prior art patents bear at least some relation to one or more of the disclosed features of the present invention:

15	<u>INVENTOR(S)</u>	<u>PATENT NO.</u>	<u>TITLE</u>
	Ritter	3,619,783	MEANS FOR DETERMINING TELEVISION CHANNEL USE IN A COMMUNITY ANTENNA TELEVISION SYSTEM
20	Haselwood et al	3,651,471	DATA STORAGE AND TRANSMISSION SYSTEM
	Haselwood et al	3,772,649	DATA INTERFACE UNIT FOR INSURING THE ERROR FREE TRANSMISSION OF FIXED-LENGTH DATA SETS WHICH ARE TRANSMITTED REPEATEDLY
25			
	Larsen	3,899,775	AUTOMATIC STORE TRANSACTION SYSTEM AND TERMINAL THEREFOR
	Miyake	3,947,624	SYSTEM FOR CONDUCTING A TELEVISION AUDIENCE SURVEY
30			
	Fuller	4,014,004	AUTOMATIC REPORT REGISTER
	Porter	4,044,376	TV MONITOR
	Thompson	4,058,829	TV MONITOR
35	Bridges, Jr. et al	4,141,078	LIBRARY CIRCULATION CONTROL SYSTEM

	Eskin et al	4,331,973	PANELIST RESPONSE SCANNING SYSTEM
	Cogswell et al	4,331,974	CABLE TELEVISION WITH CON- TROLLED SIGNAL SUBSTITUTION
5	Johnson et al	4,355,372	MARKET SURVEY DATA COLLECTION METHOD
10	Asip et al	4,361,851	SYSTEM FOR REMOTE MONITORING AND DATA TRANSMISSION OVER NON-DEDICATED TELEPHONE LINES
	Ohta	4,361,903	DATA TRANSMISSION PROCESS IN A CATV SYSTEM
15	Anderson et al	4,377,870	ELECTRONIC AUDIENCE POLLING SYSTEM
	Wright, Jr.	4,404,589	CABLE TELEVISION WITH MULTI- EVENT SIGNAL SUBSTITUTION
	Abe et al	4,471,491	SERVICE CHANNEL SIGNAL TRANS- MISSION SYSTEM
20	Gomersall et al	4,500,880	REAL TIME, COMPUTER-DRIVEN RETAIL PRICING DISPLAY SYSTEM
25	McKenna et al	4,546,382	TELEVISION AND MARKET RE- SEARCH DATA COLLECTION SYSTEM AND METHOD
	Nickerson et al	4,566,030	TELEVISION VIEWER DATA COL- LECTION SYSTEM
30	Pejas et al	4,588,881	SYSTEM FOR MONITORING THE MOVEMENTS OF GOODS INWARDS AND/OR OUTWARDS
	Kurland et al	4,603,232	RAPID MARKET SURVEY COLLEC- TION AND DISSEMINATION METHOD
35	Eglise	4,611,205	DATA COLLECTION SYSTEM
	Lurie	4,626,904	METER FOR PASSIVELY LOGGING THE PRESENCE AND IDENTITY OF TV VIEWERS

-4-

	Gomersall	4,630,108	PREPROGRAMMED OVER-THE-AIR MARKETING RESEARCH SYSTEM
5	Caswell et al	4,636,950	INVENTORY MANAGEMENT SYSTEM USING TRANSPONDERS ASSOCIATED WITH SPECIFIC PRODUCTS
	Roberts et al	4,642,685	STORING DATA RELATING TO TELEVISION VIEWING
10	Smith et al	4,644,393	MEANS FOR MONITORING PEOPLE WHO ARE WATCHING A TELEVISION SET

15 The McKenna et al '382 patent concerns,
inter alia, a data collection system for collecting
at a central location television viewing data and
retail purchase data from a plurality of cooperating
households. Each of the households includes a hand
held optical scanner for reading bar codes, i.e., UPC
codes, associated with retail products purchased by
the household. Scanned retail product purchase data
20 and the television viewing data are stored in a common
memory in the household and are periodically trans-
mitted by telephone to a central site for processing
and market research analysis.

25 The Eskin et al '973 patent, the Cogswell
et al '974 patent and the Wright, Jr. '589 patent
disclose, inter alia, a market research system utiliz-
ing a plurality of cooperating retail stores for ob-
taining and transmitting to a central location retail
product purchase information concerning a plurality
30 of cooperating panelists. The POS scanners in each
of the cooperating retail stores scan bar encoded
panelist identification cards and the UPC codes on
the products purchased by each such panelist. Each
retail store's in-store computer then stores a record
35 of the products purchased by each such cooperating
panelist, which record is subsequently transferred to
a market research company at a remote location for
analysis and possible correlation with television

viewing data obtained from the same cooperating panelists.

5 The Gomersall '108 patent is directed to an over-the-air market research system and method and discloses, inter alia, the collection of retail product purchase information from a plurality of cooperating households by means of a UPC scanner provided to each household. Alternatively, such retail product purchase information may be obtained from cooperating retail stores in a test area. Each store's computer stores and periodically forwards a record of the retail products purchased by each cooperating household, identified by a scanned or manually entered identification code for each cooperating household, which information is periodically transmitted by telephone to a central computer for analysis by market researchers. The information transmitted typically includes at least an identification of the cooperating household, an identification of the retail product purchases made by that household and the identification of the retail store transmitting the data. As disclosed in the '108 patent, the data collected, stored and transmitted by each such store may also include the price of each retail product purchased, the date of the purchase and the time of the purchase.

25 The Larson '775 patent discloses, inter alia, an automatic store transaction system in which a keyboard is provided at each POS terminal for entering data. A transceiver is also provided at each POS terminal for transmitting data to and receiving data from a central processor. The system is particularly useful for inventory control and for providing data on sales rates and checker productivity.

35 The Johnson et al '372 patent, reissued as United States Letters Patent No. Re. 31,951, discloses, inter alia, a market research data collection system in which market research data, corresponding to the

retail products purchased by a cooperating panelist, are transmitted by telephone from each cooperating household to a remotely located central computer for processing and market research analysis. The data
5 collection system includes a hand held optical scanner located in each household for scanning and storing UPC codes and for entering and storing other related data, for example, the identification of the retail store at which the retail products were purchased.

10 In addition, several of the other above-identified patents concern systems and methods for transmitting data, such as television viewing data, from a plurality of remote locations to a central location for further processing. For example, the
15 Ritter '783 patent discloses, inter alia, a system in which television viewing data is transmitted to a central location using either modulated RF signals or audio tones.

The Haselwood et al '471 and '649 patents
20 disclose, inter alia, systems in which a computer at a central location periodically contacts by telephone each of a plurality of remotely located data storage and handling units in a plurality of cooperating households. Television viewing data are then transmitted
25 from the remotely located data storage and handling units to the central location by telephone in the form of frequency modulated audio tones.

The Miyake '624 patent discloses, inter alia, a system in which television viewing data from
30 one or more televisions in the household are transmitted in the form of a data pulse train from one transmitter over transmission lines to a survey center where the information is processed.

The Porter '376 patent and the Thompson
35 '829 patent disclose, inter alia, television viewing data collection systems in which television viewing data from several television receivers in one household

are transmitted to a single household data collector by, for example, a low power radio frequency transmitter. Subsequently, the accumulated television viewing data for the household is transmitted by telephone to
5 a central location.

The Asip et al '851 patent discloses, inter alia, a data collection system for transmitting television viewing data by telephone to a central office computer.

10 The Ohta '903 patent discloses, inter alia, a bidirectional cable television system in which remote terminals in the system are polled by the cable head end for transmitting data thereto.

The Nickerson et al '030 patent discloses,
15 inter alia, a television receiver monitoring system for collecting data concerning viewing habits and viewing preferences of television viewers located in a plurality of cooperating households and for transmitting that data by telephone to a central location
20 for further processing and analysis. A remote unit in each remotely located cooperating household includes a microprocessor, a control memory, a data store memory and a modem for initiating a telephone call to the central location. The data store memory stores data
25 concerning television channel selection and the times thereof and television viewer reaction data. At a preselected time, each such remote unit initiates a telephone call to the central location and transmits the collected data stored in the data store memory by
30 telephone to the central location. During the telephone call, the central location can transmit new control information to each remote unit for storage at the remote unit and for controlling the operation of the remote unit until the time of the next telephone
35 communication between the remote unit and the central location.

The Lurie '904 patent discloses, inter alia, a television viewing monitoring system for determining and storing the presence of individual television viewers by means of headphones that both receive the
5 audio portion of a television broadcast and transmit by means of an infrared signal headphone identification data to the monitoring system when a particular headphone is in use.

The Roberts et al '685 patent discloses,
10 inter alia, a television viewing data collection system in which television viewing data from a plurality of homes are transmitted to a central computer by means of a switched telephone network.

The Smith et al '383 patent discloses, inter
15 alia, a system for monitoring the number of people watching a television receiver and for transmitting data relating to the number of people watching a television receiver by telephone to a central location for further processing.

20 The Fuller '004 patent discloses, inter alia, a mobile vehicle data storage and transmission system that utilizes a radio frequency transmitter-receiver.

The Bridges, Jr. et al '078 patent discloses,
25 inter alia, a library book circulation control system utilizing optical scanners for reading bar codes associated with library books.

The Anderson et al '870 patent discloses,
inter alia, an audience polling system for use by
30 lecturers in which a number of wireless transmitters are used for transmitting audience responses to questions.

The Abe et al '491 patent discloses, inter alia, a service channel signal transmission system.

35 The Gomersall et al '880 patent discloses, inter alia, a computer operated retail pricing display system for displaying pricing and other information

in real-time at the shelf or bin location of a product in a retail store.

The Pejas et al '881 patent discloses, inter alia, an inventory control system having an optical scanner for scanning bar codes associated with particular inventory items.

The Kurland et al '232 patent discloses, inter alia, a market survey collection and dissemination system that provides for the downloading of survey questionnaires from a central processor by telephone or by a cable television channel. The Eglise '205 patent discloses, inter alia, a system for auditing vending machines.

Finally, the Caswell et al '950 patent discloses, inter alia, an inventory control system that utilizes transponders associated with particular products for inventory control purposes.

In addition to the above-identified patents, several prior art systems have been commercially used in retail stores for collecting market research information of various types. For example, a system corresponding at least in part to that disclosed in the above-identified Eskin et al '973 patent and the Cogswell et al '974 patent and the Wright, Jr. '589 patent has been used to obtain market research data from a plurality of cooperating retail stores. The market research data obtained thereby, however, is obviously dependent upon cooperation by the store operators and upon the data collection and processing characteristics of each in-store computer or controller that controls the POS scanners/registers. Similarly, a prior art commercially operated system has been used in which a coupon dispensing device is positioned at each check-out counter in a retail store for dispensing a manufacturer's discount coupon to purchasers of products competitive with the manufacturer's product associated with the discount coupon. The latter system

-10-

is believed to be electrically connected in the store loop, i.e., in the store data and control loop containing the POS scanners/registers and the in-store scanner controller and computer, thereby enabling the device
5 to dispense coupons in response to the purchase of such competitive products. In addition, other prior art commercially available devices are designed to be electrically connected to the store loop and are used for many different purposes, such as for monitoring
10 time and attendance of retail store cashiers.

While many of the above prior art systems and methods constitute significant improvements over prior manual systems and methods of collecting market research data, significant disadvantages exist with
15 respect to many of the above prior art systems and methods. For example, there is a wide variety of manufacturers and types of POS systems for retail stores. Although each type of POS system performs the same basic functions as other POS systems, each
20 different type of POS system performs those functions generally in a unique way. Consequently, the collection of market research data is limited by the methods and procedures in use in a particular POS system. An even greater variety of different summarization schemes
25 in use in connection with such POS systems differing in, for example, level of detail, frequency of collection, speed of collection and accuracy of the collected data, complicates even further the collection of market research data from many retail stores. The physical
30 logistics associated with collecting such data are immense in view of the fact that there are many thousands of retail stores from which market research data desirably is collected about tens of thousands of different retail products. Much highly desirable
35 market research data also is lost or not collected as a result of the various existing summarization schemes in use by in-store controllers and computers or by

central or host computers associated with the headquarters of a retail store chain.

5 Additionally, unacceptable time delays often occur between the occurrence of a retail sales transaction and the receipt of the sales transaction data by a market researcher. Furthermore, most existing market research in-store data collection systems require the active participation and cooperation of the store operators, including cooperation with respect to the
10 use of special procedures, special scheduling and the use of the in-store controllers or computers. As a result, many retail store operators are unwilling to cooperate in collecting, storing and transmitting market research retail sales data due to the potential
15 interference, real or imagined, with normal store operations.

Thus, a long-felt want and need has existed for a new and improved in-store market research retail sales data collection system and method that are substantially totally passive or non-invasive with respect
20 to the regular operations and equipment of retail stores, thereby obviating the concerns referred to above of many store operators. Preferably, any such data collection system and method should also be independent of the in-store POS scanner/register controller
25 and computer and also independent of host computers at the headquarters of retail store chains, thereby enabling market research data to be collected, stored and transmitted to a central location in accordance
30 with the particular format found most advantageous by market researchers.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a new and improved market research system and
35 method.

Another object of the present invention is to provide a new and improved, non-invasive system

-12-

and method for conducting market research with respect to products sold by a plurality of retail stores.

Another object of the present invention is to provide a new and improved system and method for
5 conducting market research with respect to the purchasing habits of a plurality of cooperating consumers.

An even further object of the present invention is to provide a new and improved system and method for conducting market research with respect to the
10 products purchased by customers of retail stores without requiring the active cooperation or participation by either the customers or the retail stores.

Another object of the present invention is to provide a new and improved system and method for
15 conducting market research in which market research retail sales transaction data are collected on a real-time basis and transmitted in an expeditious manner to a central site for use by market researchers.

Finally, an additional object of the present
20 invention is to provide a new and improved system and method for conducting market research through a network of cooperating retail stores in which accurate, verifiable retail sales transaction data are collected, processed and made available to market researchers
25 independently of the activities of the retail stores or retail store chains.

Briefly, the present invention constitutes a new and improved system and method for conducting market research through a plurality of cooperating
30 retail stores and, if desired, through a plurality of cooperating consumer panelists. In accordance with the present invention, disposed in each cooperating retail store is an in-store device for collecting, processing and storing on a real-time basis retail
35 sales transaction data in a totally passive or non-invasive manner with respect to the on-going operations of the retail store. However, the in-store device

does not interfere with or require the active participation of the in-store controller or computer controlling the normal operation of the one or more POS terminals in each retail store. Periodically, each in-store device transmits the retail sales transaction data it has collected through a bidirectional communications network to a central site for further processing and use by market researchers.

Each retail sales transaction detected, interpreted, processed and stored by the in-store device normally contains data corresponding to the identification of the retail store, the date of the transaction, the time of day of the transaction, the Universal Product Code (UPC) of the retail product involved in the transaction, the unit price of that product, the quantity purchased of that product, the identification of the POS terminal (scanner/register) at which the transaction occurred and a brief description of the product. Each such transaction may also include data corresponding to the unique identification code of a participating consumer panelist and may also reflect coupon redemptions, sales taxes, the method of payment, returns and/or voided purchases or transactions.

In addition to detecting, interpreting, processing and storing in one or more different formats data reflecting the above transactions, the in-store device can detect, process and store data reflecting the purchases made by each one of a plurality of cooperating consumer panelists. Thus, the transactions collected by the in-store device enable a "market basket" analysis to be performed by identifying and storing as a group all of the products purchased by each such cooperating customer panelist and, in fact, by each customer of the retail store during each trip through a check-out counter of the retail store.

-14-

Each in-store device basically consists of a substantially totally passive or non-invasive sensor assembly, a sensor interface, a store loop communications adapter, a central processing unit, a random access memory, a processed data storage device, a power monitor for determining whether or not the central processing unit is operating properly and a communications modem for connecting the in-store device to a central site communications network. The in-store device may utilize one of a number of conventional data transmission protocols and, if desired, encryption schemes in communicating with the central site to ensure the highest reliability and security of the collected market research data.

Importantly, each in-store device operates in an unattended mode and requires no intervention by the retail store operators or by the retail store's POS terminals, controller or computer. The system and method of the present invention require no software and program modification to each retail store's controller or computer used in controlling the normal operations of each retail store. Each in-store device continuously monitors, detects, interprets, processes and stores data from its retail store under the control of an operating program stored in the in-store device, which program may be periodically updated or modified from the remotely located central site. The central site includes one or more central computers for collecting data from each in-store device in the cooperating retail stores and for further processing the data for subsequent analysis and use by market researchers.

BRIEF DESCRIPTION OF THE DRAWING

The above and other objects and advantages and novel features of the present invention will become apparent from the following detailed description of the preferred embodiment of the present invention illustrated in the accompanying drawing wherein:

FIG. 1 is a schematic illustration of a market research system and method constructed in accordance with the principles of the present invention;

FIG. 2 is a schematic diagram of a typical in-store device that forms a portion of the system and method of FIG. 1;

FIG. 3 is a side view of a non-invasive sensor assembly disposed physically adjacent to a portion of a store POS terminal/controller loop, constructed in accordance with the principles of the present invention and forming a part of the in-store device of FIG. 2;

FIG. 4 is an enlarged, broken-away perspective view of the sensor assembly of FIG. 3;

FIG. 5 is an electrical circuit diagram of the sensor assembly of FIGS. 3 and 4;

FIG. 6 is an electrical circuit diagram of a sensor interface that forms a portion of the in-store device of FIG. 2;

FIG. 7 is a schematic diagram of the components of the system and method of FIG. 1 located at the central site; and

FIG. 8 is an illustrative flow chart depicting a portion of the operation of the in-store device of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

SYSTEM 10 OVERVIEW

Referring initially to FIG. 1 of the drawing, there is illustrated a new and improved market research method and system 10 constructed in accordance with the principles of the present invention. The method and system 10 of the present invention may be used in any market area where there are cooperating retail stores that utilize Point-Of-Sale (POS) optical scanners in their normal retail store operation to detect bar coded information, such as a Universal Product Code (UPC), affixed to the retail products being sold.

-16-

More specifically, each cooperating retail store in the system 10 is provided with an in-store device 12 that is connected by a sensor assembly 14 to a conventional store data and control loop 16 in a substantially totally passive or non-invasive manner so as not to interfere with or otherwise jeopardize the normal operations of a plurality of POS terminals or optical scanners/registers 18 or of a store controller or computer 20, all of which are interconnected by the store loop 16. Typically, the store's controller 20 controls the operation of the scanners/registers 18 by the exchange of digital data signals through the store loop 16. The sensor assembly 14 preferably is disposed adjacent a portion of the store loop 16 to enable the digital data signals present in the store loop 16 to be detected by the sensor assembly 14 and to be interpreted, locally processed and eventually transmitted by the in-store device 12 through a communications network 22 to a central site 24 for further processing and subsequent analysis and review by market researchers. In accordance with the preferred embodiment of the present invention, the system 10 includes approximately 6,000 in-store devices 12, one in each of approximately 6,000 cooperating retail stores, all connected by the communications network 22 to the central site 24.

COMMUNICATIONS NETWORK 22

In the preferred embodiment of the present invention, the communications network 22 through which the in-store devices 12 communicate with the central site 24 consists of a dial-up or switched line telephone connection to a nearby local node on a private X.25 packet-switched data communications network. Such data networks are conventional, per se; and a number of such data networks are currently in commercial operation in this country. For example, a subsidiary of Dun & Bradstreet, Inc. operates such a

data network under the name Dunsnet. That data network is currently being used by customers to obtain credit ratings on companies and to obtain market research information reports. Each local node on the Dunsnet information network basically consists of a bank of telephone modems, each such modem connected to a data packet assembler/disassembler. The modems are conventionally accessed by dial-up telephone lines.

In another embodiment of the present invention, the communications network 22 through which the in-store devices 12 communicate with the central site 24 consists of a conventional dial-up or switched line telephone connection from each retail store directly to the central site 24 over a conventional public telephone network.

In an even further embodiment of the present invention, the communications network 22 through which the in-store devices 12 communicate with the central site 24 consists of a radio modem connection to a nearby base station forming a node on a private packet-switched data network as discussed above. The private network is connected directly to the central site 24. An advantage of this embodiment of the present invention is that the radio modem requires no telephone line connection to the in-store device 12. Furthermore, the radio modem is useful when it is inconvenient or otherwise impractical to install a telephone line in a retail store for market research data collection. Suitable radio modems for use in the communications network 22 in accordance with this embodiment of the present invention are available from a number of different manufacturers. For example, a suitable radio modem is a "KDT" TM portable data terminal Model No. N1323A available from Motorola, Inc. and described in a publicly available Motorola instruction manual numbered 68P81035C35-B, copyrighted in 1985 by Motorola, Inc. The serial port on the radio modem is connected

-18-

to a serial port on the in-store device 12 through an RS-232 adapter. A stored program in the portable data terminal Model No. N1323A relays messages between the radio network and the in-store device 12, providing
5 the equivalent of a 4800 baud continuous communication link between the in-store device 12 and the central site 24.

In another alternative embodiment of the present invention, the communications network 22
10 through which the in-store device 12 communicates with the central site 24 may take the form of a Very-Small-Aperture-Terminal (VSAT) located on the exterior roof or wall of the retail store for communicating via an over-the-air Ku band microwave link to a trans-
15 ponder in a satellite in a geostationary earth orbit. The satellite is linked to an earth transceiving station at the central site 24. Such satellite communication systems are conventional and commercially available. For example, a representative commercially
20 available satellite communication system is operated by GTE Spacenet under the name SKYSTAR SYSTEM. In using the SKYSTAR SYSTEM in accordance with this embodiment of the present invention, a central Hub Station of the SKYSTAR SYSTEM is located at the central
25 site 24 for communicating in the Ku frequency band via a satellite with the Very-Small-Aperture-Terminals remotely located at the retail stores in the system 10. The communications network 22 constructed in accordance with this embodiment of the present invention
30 requires no telephone line connection to the in-store devices 12 and also may be used when it is inconvenient or otherwise impractical to install a telephone line in a retail store for market research data collection.

35

IN-STORE DEVICE 12

In accordance with an important feature of the present invention, the components of each in-

store device 12 are depicted in FIG. 2. As discussed hereinabove, the sensor assembly 14 is disposed adjacent to the store loop 16. For example, the sensor assembly 14 (FIG. 3) may be placed physically adjacent to the electrical signal conductors or cable forming the store loop 16 or adjacent to an electrical connector in the store loop 16, for example, an electrical connector in the vicinity of the controller 20. The sensor assembly 14 detects electrical signals, typically digital data pulses, present in the store loop 16 and passing between the POS scanners/registers 18 and the controller 20. The sensor assembly 14 preferably is substantially totally passive or non-invasive to the store loop 16 and therefore can send no information to the store loop 16. Thus, the sensor assembly 14 and the in-store device 12 cannot interfere with the normal operations of the store loop 16, the scanners/registers 18 and the POS controller or store computer 20.

The in-store device 12 also includes a sensor interface 26 that both supplies low voltage (five volts), direct current electrical power to the sensor assembly 14 and reconstructs the digital data signals present on the store loop 16 from the time varying electrical signals or pulses received from the sensor assembly 14. The store loop digital data signals reconstructed by the sensor interface 26 are provided to a conventional store loop adapter 28 that decodes the digital signals from the sensor interface 26 and passes the decoded information to a Central Processing Unit (CPU) 30. The particular store loop adapter 28 selected for use in the in-store device 12 will obviously depend upon the particular type of scanners/registers 18 and controller 20 in use in that store. The store loop adapter 28 may take the form of a Model AW552 controller available from AW Computer Systems, Inc. of Mt. Laurel, New Jersey, USA (telephone No.

-20-

609/234-3939) for use with store loops 16 having National Cash Register (NCR) registers 18, for example, NCR Models 255, 2552 and 1255 register systems. A similar Model AW3863 controller may be used for a
5 store loop 16 utilizing one or more types of registers 18 manufactured by the IBM Corporation. In addition, the store loop adapter 28 may take the form of a Retail-Net Coprocessor available from Avalon Design and Manufacturing Inc. of Costa Mesa, California, USA
10 (telephone No. 714/432-7227). Furthermore, when Model No. DTS545 registers 18 manufactured by Datachecker Systems, Inc. are used, the digital signals transmitted over the store loop 16 have a very simple, asynchronous communications protocol that enables a simple
15 serial input port of the in-store device 12 to be used as the store loop adapter 28.

The operation of the CPU 30 is under the control of a software program contained in a variable or random access memory (RAM) 32. The CPU 30 monitors
20 the incoming data from the store loop adapter 28 and processes that data in accordance with the programmed instructions contained in the RAM 32. Processed data is periodically written onto a direct access storage device (DASD) 34 that may take the form of a hard
25 disk memory. Periodically, i.e., once every several hours or once a day or once every several days or
once a week, summarized retail sales transactions formatted by the CPU 30 in accordance with the programmed instructions contained in the RAM 32 may be
30 transferred from the DASD 34 by means of a communications modem 36 to the central site 24.

In a preferred embodiment as depicted in FIG. 2, the modem 36 takes the form of a conventional telephone modem that utilizes a dial-up or switched
35 line telephone 38 for connecting the in-store device 12 to a nearby local node on a private X.25 packet-switched data communications network 22 and then

directly to the central site 24. Obviously, if the telephone 38 is shared with the retail store in which the in-store device 12 is located, the communications session between the in-store device 12 and the central site 24 will occur during "off" hours when the telephone 38 is not being used by personnel within the retail store. During a communications session between the in-store device 12 and the central site 24, data corresponding to retail sales transactions collected and stored by the in-store device 12 are up-loaded as discussed above to the central site 24. During the same communications session, the central site 24 can remotely update or change the operating program stored in the RAM 32 and perform testing, as required. The remote updating or change to the operating program stored in the RAM 32 and the remote testing are performed in accordance with standard, well known techniques that are conventional, per se.

The CPU 30, the RAM 32 and the DASD 34 may be embodied in a commercially available IBM Personal System/2 (PS/2) Model 30 microprocessor. The sensor interface 26, the store loop adapter 28 and the communications modem 36 each represent conventional printed circuit boards or cards that may be plugged into the expansion bus of the IBM PS/2 Model 30 microprocessor.

That microprocessor in other applications is designed to operate conventionally in an attended fashion with an operator, a keyboard and a computer display screen. Because that microprocessor preferably operates in an unattended manner when used in the in-store device 12, a power monitor 40 is provided to take the place of an operator, keyboard and display screen. The power monitor 40 is conventional, per se, and basically is used to apply conventional 120 volts alternating current power through a power connector 42 to the microprocessor and also to disconnect

-22-

power to the microprocessor if the program being executed by the CPU 30 does not reset an internal timer in the power monitor 40 periodically, for example, once every hour. If not properly reset due to a failure in the hardware or software, the power monitor 40 interrupts power to the microprocessor and delays the reapplication of power thereto for a short time, for example, for approximately one minute. Thereafter, the power monitor 40 reapplies power to the microprocessor which then goes through a standard initialization subroutine in order to attempt to obviate whatever failure or malfunction was previously present in the microprocessor.

While the power monitor 40 is a separate unit from the IBM PS/2 Model 30 microprocessor used to form the major portion of the in-store device 12 in accordance with the preferred embodiment of the present invention, all of the components of the in-store device 12 are enclosed within a tamper-proof security enclosure 44 to discourage tampering with the in-store device 12.

SENSOR ASSEMBLY 14

In accordance with a further important feature of the present invention, the sensor assembly 14 (FIGS. 3-5), used in detecting digital data signals present on the store loop 16, is formed as a small unobtrusive device and includes a molded plastic housing 48 that, in a specific embodiment has a length of approximately 1.75 inches, a width of approximately 1.5 inches and a height or depth of approximately .75 inch. The sensor assembly 14 preferably operates on a capacitive principle and, therefore, makes no intrusive physical or electrical connection to the store loop 16. For example, as depicted in FIG. 3, the sensor assembly 16 is disposed physically adjacent to and in physical contact with a portion of the store loop 16. That portion of the store loop 16 depicted

in FIG. 3 in dotted line form may be an elongate portion of the data carrying electrical cable of the store loop 16 disposed generally parallel to the length of an antenna A or, alternatively, an electrical connector within the store loop 16. The sensor assembly 14 may be physically secured to that portion of the store loop 16 by any conventional technique, for example, by one or more strips of adhesive tape 46. In the preferred embodiment of the present invention, the sensor assembly 14 is secured to an electrical connector in the store loop 16 immediately adjacent to the controller 20. Alternatively, plastic cable clips (not illustrated) secured to the molded plastic housing 48 may be used securely to attach the sensor assembly 14 to an electrical cable portion of the store loop 16.

As depicted is FIG. 4, the electrical components of the sensor assembly 14 are mounted on a printed circuit board 50, dimensioned to be received within and securely retained within the housing 48 by a lower end cover 52. The housing 48 includes a lower internally formed recess or ridge 54 dimensioned to receive and position the lower end cover 52 within the housing 48. Preferably, the lower end cover 52 is a rigid, molded plastic component that includes an electrically conductive copper ground plane 56 formed on the interior side of the lower end cover 52 that is disposed beneath and adjacent to the under side of the printed circuit board 50. The housing 48 includes a pair of integrally formed, spaced-apart, internally threaded bosses 58 for receiving and securely retaining a pair of threaded fasteners 60. The fasteners 60 extend through a pair of apertures 62 formed through the lower end cover 52 and through a pair of spaced apart aligned slots or recesses 64 formed in the printed circuit board 50, thereby to secure the printed circuit board 50 and the components mounted thereon

-24-

and the lower end cover 52 to the housing 48. The sensor assembly 14 also includes a locking nut 66 and a washer 68 for securing the lower end cover 52 to the printed circuit board 50 in a fixed, spaced-apart relationship (FIG. 3). The locking nut 66 is internally threaded for engagement with a downwardly depending, externally threaded elongate coaxial cable connector 70. The printed circuit board 50 is maintained in a fixed, spaced-apart relationship with respect to the lower end cover 52 and the ground plane 56 by a metal spacer 72 (FIG. 3) formed as an enlarged portion of the connector 70. The spacer 72 is physically positioned between and in contact with the ground plane 56 and the lower or under side of the printed circuit board 50.

A preferred embodiment of the electrical circuit of the sensor assembly 14 is depicted in FIG. 5. The electrical components discussed hereinafter with respect to FIG. 5 are also depicted in FIGS. 3 and 4 as mounted on the printed circuit board 50 and as enclosed within the housing 48. The sensor assembly 14 includes the two-conductor, coaxial cable connector 70, the outer conductor of which is directly electrically connected both to the ground plane 56 through the spacer 72 and to the outer conductor of a two conductor coaxial cable 74 (FIGS. 1 and 2) that electrically interconnects the sensor assembly 14 to the sensor interface 26 of the in-store device 12.

When a digital voltage or current signal is present along the electrical cable and connectors forming the store loop 16, the electromagnetic field generated by such a signal is detected by an elongate antenna A that extends above and parallel to the upper surface of the printed circuit board 50. In a specific embodiment of the present invention, the elongate antenna portion of the antenna A is approximately one inch long and extends parallel to and along the

length of the upper surface of the printed circuit board 50. As so configured and physically disposed, the antenna A is oriented slightly beneath and along the length of the upper surface of the housing 48
5 directly beneath a portion of the store loop 16, for example, an elongate conductive cable or electrical connector, to maximize the detection of the electromagnetic field associated with digital signals present in the store loop 16. The antenna A is designed to
10 operate effectively as much as one-half inch away from the store loop 16. The antenna A basically capacitively couples the sensor assembly 14 to an electrically conductive portion of the store loop 16; however, the capacitance of the antenna A in relation to the
15 store loop 16 is extremely small, for example, on the order of .001 picofarad. The electromagnetic field detected by the antenna A is in the direction of and proportional to the magnitude of the digital electrical signal present in the store loop 16.

20 The electrical signal detected by the antenna A is passed by a coupling capacitor C1 to a non-inverting, field-effect transistor input of an operational amplifier 76 which is connected and operates as a high impedance voltage follower. The coupling capacitor C1 blocks any static electric charges that may be
25 present while passing electrical signals detected by the antenna A to the operational amplifier 76. A pair of resistors R6 and R2 are connected as a voltage divider to provide a direct current (DC) voltage of
30 approximately 2.5 volts to the non-inverting input of the operational amplifier 76 through a resistor R1. The operational amplifier 76 basically serves as an impedance matching device with an input impedance on the order of 10 megohms and an output impedance of
35 approximately 10,000 ohms as established by a variable resistor R3. The field-effect transistor input of

-26-

the operational amplifier 76 enables it to operate effectively at extremely high input impedances.

The sensor assembly 14 receives electrical power of approximately 5 volts DC from the sensor interface 26 via the center conductor 78 of the connector 70. The electrical power received from the sensor interface 26 to operate the sensor assembly 14 is blocked at its input by a coupling capacitor C3 and is routed through a low pass filter circuit formed by an inductor L1 and a capacitor C4 to provide power to the operational amplifier 76 and to a second operational amplifier 80. The resistors R2 and R6 form a voltage divider to supply the desired amount of bias voltage to the operational amplifier 80 through a resistor R4.

The output signal from the operational amplifier 76 is attenuated by the variable resistor R3 which serves as a trimmer potentiometer; and the attenuated signal is supplied through a coupling capacitor C2 to the operational amplifier 80 that is connected as a differentiator or high pass filter. The capacitor C2 and a feedback resistor R5 connected to the inverting input of the operational amplifier 80 configure the operational amplifier 80 to function as desired as a differentiator. The output signal from the operational amplifier 80 consists of a series of positive or negative going electrical pulses that represent signal transitions, i.e., the leading and trailing edges of electrical signals, on the store loop 16. The frequency of the output signal of the operational amplifier 80 depends on the frequency of the signals present on the store loop 16. The output signal from the operational amplifier 80 is passed through the coupling resistor C3 to the center conductor 78 of the coaxial cable connector 70 and from there via a coaxial cable 82 (FIG. 2) to the sensor interface 26. The signal present on the center conductor of the coaxial cable 82 is a composite signal

formed by the 5 volt DC power component to which is added the time varying output signal from the sensor assembly 14 having, for example, an amplitude of approximately 100 millivolts, positive or negative, and a pulse width on the order of approximately 1 micro-second.

The input impedance of the sensor assembly 14 is approximately 10 megohms; and the output impedance is approximately 600 ohms. The frequency response of the sensor assembly 14 is from approximately 20,000 Hz to approximately 400,000 Hz. As described hereinabove, the sensor assembly 14 behaves essentially as a low frequency, broad band amplifier to enable the sensor interface 26 to reconstruct digital data signals of various encoding schemes and of various transmission rates present on the store loop 16.

Suitable component values for the electrical components of the sensor assembly 14 are set forth below:

<u>Electrical Component</u>	<u>Component Value</u>
A	Approximately 1 inch long
C1	100 picofarads
C2	.004 microfarads
C3, C4	220 microfarads
L1	1 millihenry
R1	10 megohms
R2, R3, R4, R5, R6	10,000 ohms

The operational amplifiers 76 and 80 may be component parts of a single integrated circuit available from any one of a number of different manufacturers. For example, a model LM353 operational amplifier have been found to be suitable for use as the operational amplifier 76 or the operational amplifier 80. For space considerations, two smaller capacitors may be connected electrically in parallel to form each of the capacitors C3 and C4 (FIGS. 3-4).

-28-

SENSOR INTERFACE 26

The electrical circuit diagram for the sensor interface 26 is depicted in FIG. 6. The sensor interface 26 is located within the in-store device 12 and includes a sensor power interface 84 formed by a resistor R1, an inductor L1 and a capacitor C1. The sensor power interface 84 provides the low voltage, direct current power to operate the active components of the sensor assembly 14. Power from the power interface 84 is blocked from the rest of the circuitry of the sensor interface 26 by a coupling capacitor C2. The inductor L1 blocks the high frequency signal component present on the signal lead from the sensor assembly 14. The coupling or input capacitor C2 blocks the direct current from a variable gain operational amplifier 88 while passing the input pulses from the sensor assembly 14 to the inverting input of the operational amplifier 88. The amplifier 88 is connected as an inverting amplifier; and the non-inverting input of the amplifier 88 is biased to direct current voltage level of approximately +2.5 volts through the resistors R2, R4 and R5. The gain of the amplifier 88 is adjusted from a minimum gain of approximately unity to a maximum gain of approximately eleven by adjusting the variable feedback resistor R7. The gain of the amplifier 88 is set when the in-store device 12 is initially installed in a particular retail store to provide the proper output signals to the store loop adapter 28 depending upon the particular characteristics of the store loop 16 and of the scanners/registers 18 and of the controller or store computer 20.

The output of the amplifier 88 is provided to the non-inverting input of an operational amplifier 90 connected as a unity-gain voltage follower, the output of which is fed to a Schmitt Trigger 92 that is connected as a NAND gate and that provides noise

immunity to or suppression of signals having magnitudes less than the expected magnitudes of signals of interest. In addition, it provides an output digital signal having rapid rise times as compared to the
5 slower rise times associated with the input signal to the Schmitt Trigger 92.

When a positive going pulse from the amplifier 90 exceeds a threshold level of the Schmitt Trigger 92, the Schmitt Trigger 92 switches to a low
10 output voltage level. If the output voltage from the amplifier 90 falls below a second, lower threshold level, the Schmitt Trigger 92 switches to a high output voltage level.

A second Schmitt Trigger 94 connected as a
15 NAND gate serves as an inverter for providing an input signal of proper polarity to a conventional line driver 96. The line driver 96 is a standard RS232 line driver that converts an input signal having a logic level 1 to an output signal with a -12 volt DC level. Similar-
20 ly, an input signal having a logic level 0 is converted to a +12 volt DC output signal. The amplifiers 88 and 90, the Schmitt Triggers 92 and 94 and the line driver 96 are conventional integrated circuits available from any one of a number of integrated circuit
25 manufacturers.

Specific values of the electrical components used in the electrical circuit (FIG. 6) for the sensor interface 26 are as follows:

30	<u>Electrical Component</u>	<u>Component Value</u>
	C1	1 microfarad
	C2	.01 microfarad
	L1	1 millihenry
	R1	22 ohms
	R2, R3, R4, R5, R6, R8	10,000 ohms
	R7	100,000 ohms

35

The output signal from the sensor interface 26 via the line driver 96 is suitable for use as an

-30-

input signal to any one of a variety of different types of store loop adapters 28 discussed hereinabove.

CENTRAL SITE 24

FIG. 7 is a schematic diagram of typical components of the market research system 10 that would be located at the central site 24 of the system 10. As depicted, a telephone 102 represents a telephone connection from the communications network 22 to a conventional telephone modem 104 that, in turn, is connected to an IBM model 3725 communications controller 108. The communications controller 108 is directly connected to an IBM model 3090-200 central processor 110 for enabling the central processor 110 to communicate with the communications network 22. The central processor 110 is a very large central processing unit that receives incoming data from the many retail stores in the system 10 through the communications network 22 and that formats that data for further processing at the central site 24. In addition, the central processor 110 formats output data for delivery to customers of the market research system 10 and also handles the updating of or modifications to the operating instructions or programs stored in the RAMs 32 of the in-store devices 12.

After initial editing and formatting, the incoming data from the communications network 22 is transferred to a shared, very large direct access storage device (DASD) 112. The DASD 112 serves as a very large data base having a storage capacity of billions of bytes of information. Any one of a number of commercially available data storage devices, for example, IBM model 3380 memory devices, may be interconnected or configured to form the DASD 112 at the central site 24.

An IBM model 3090-600 central processor 114 shares the DASD 112 with the central processor 110 and is used to perform the many calculations required

on the input data delivered from the retail stores and also to perform statistical calculations necessary in producing output reports for customers of the market research system 10.

5

OPERATION OF SYSTEM 10

FIG. 8 depicts a flowchart setting forth the basic operation of the system 10 and, more particularly, of each in-store device 12. The various steps depicted in the flowchart of FIG. 8 are carried out by the CPU 30 (FIG. 2) under the control of the operational instructions or program contained in the RAM 32, as periodically updated or modified by downloaded data and instructions from the remotely located central processor 110.

15

An initialization subroutine is executed upon power-up of the in-store device 12 and after each communications session with the central site 24. The real-time clock contained in the in-store device 12 is synchronized with the last time check received from the central site 24. Unneeded "snapshot" memory files contained in the RAM 32 are deleted; and the monitoring program for controlling the operation of the in-store device 12 through the CPU 30 is loaded into the RAM 32 and initiated.

20

The above initialization subroutine is followed by a "SNAP?" subroutine which determines if a "snapshot" of the data temporarily stored in the RAM 32 should be taken. Typically, all collected and processed data from the store loop 16 temporarily stored in the RAM 32 are removed from the RAM 32 and stored in any one of a number of different formats in the DASD 34. This transfer of data from the RAM 32 to the DASD 34 is performed every few minutes so that, in the case of a power outage to the in-store device 12, the device 12 can automatically recover and resume the operations it was performing at the time of the power outage.

30

35

-32-

If a "snapshot" is to be taken, a "DO
SNAPSHOT" subroutine is executed during which the
data files temporarily stored in the RAM 32 are trans-
ferred to the DASD 34; and a timer is set to indicate
5 when the next "snapshot" subroutine is to be executed.

Thereafter or in the event that a "snapshot"
subroutine is not to be executed, a "HOST?" subroutine
is executed. This subroutine determines if a communi-
cations session with the central site 24 is to be
10 executed by the in-store device 12. Each in-store
device 12 is assigned a periodic communications session
schedule, for example, a nightly communications
schedule, along with alternative times if an attempt
to establish communications with the central site 24
15 is unsuccessful.

If it is time for a communications session
with the central site 24, a "DO HOST COMMUNICATIONS"
subroutine initially writes any necessary information
files, for example, files containing performance data
20 relating to the operation of the in-store device 12,
to the DASD 34. During this subroutine, active moni-
toring of the store loop 16 is interrupted.

A conventional communications subroutine is
then initiated which controls the transfer of data
25 and instructions between the in-store device 12 and
the central site 24. A typical communications session
initially involves determining whether the telephone
38 (FIG. 2) is in use and, assuming it is not in use,
accessing the telephone 38 and dialing the telephone
30 number of the nearest local node on the private packet-
switched data network referred to hereinabove. If a
telephone connection is successfully established with
a node on the data network, network routing commands
are exchanged in order to establish a connection be-
35 tween the in-store device 12 and the central site 24.
Assuming that a connection is successfully established

with the central site 24, a series of log-on and password or security commands are transmitted to prevent unauthorized access to the central site 24.

Once a communications session is successfully established with the central site 24, the in-store device 12 issues commands to upload its data files from the DASD 34 to the central processor 110 and the DASD 112. In addition, status and diagnostic data may be uploaded at this time from the in-store device 12 to the central site 24. Subsequently, various parameters, such as the time to initiate a communications session, may be downloaded from the central site 24 to the in-store device 12 along with updated or modified programs or operating instructions for controlling the operation of the in-store device 12. Clock synchronization data is then downloaded from the central site 24 to the in-store device 12 for use in the initialization subroutine referred to hereinabove. The communications subroutine being executed by the CPU 30 in the in-store device 12 then logs-off from the central site 24 and from the communications network 22 and restores the telephone 38 to its normal status in which it is available for use by personnel within the retail store. After such a "DO HOST COMMUNICATIONS" subroutine, the CPU 30 executes the initialization subroutine referred to above.

In the event that it is not time for a communications session with the central site 24, a "DATA?" subroutine is executed in which it is determined whether or not there is any data present in a buffer memory in the store loop adapter 28 awaiting processing by the CPU 30. If no data is present in the buffer memory of the store loop adapter 28, control passes to the "SNAP?" subroutine discussed above.

If data is present in the buffer memory of the store loop adapter 28, a "GET CHARACTER" subroutine is performed. This subroutine obtains a single data

-34-

character from the buffer memory in the store loop adapter 28 and temporarily stores it in a pending buffer memory if that character is part of a transaction of interest.

5 Subsequently, a "PUT CHARACTER INTO TRANSACTION" subroutine decodes the character received from the buffer memory of the store loop adapter 28 and builds a complete transaction of interest, one character at a time. For example, when a retail product is scanned by the scanner/register 18, a signal is passed by the store loop 16 to the controller 20 identifying the specific scanner/register 18 involved in that transaction. Subsequently, the function being performed in the transaction, for example, the function of scanning, is normally identified, typically followed by a twelve character Universal Product Code (UPC) and, possibly, by the quantity of the items purchased with that specific code. Typically, the above information is accumulated by the controller 20, one character at a time. When the information is complete, the controller 20 normally responds with both the current price and a description of the item that was scanned, which information is addressed to the particular scanner/register 18 that performed the scanning operation. 25 The above information constitutes a typical retail sales transaction that is monitored and built up one character at a time by the in-store device 12 via this program subroutine.

Control then passes to a "TRANSACTION COMPLETE?" subroutine that determines whether a transaction has been completely collected. A particular transaction might involve twenty-five to thirty characters so that the above operational loop may have to be executed at least that many times in order to arrive at a complete transaction. Typically, a complete transaction is signified by either an end of transmission character or by getting the last character of 35

the descriptive information involved in the transaction.

If all of the characters have been received to form a complete retail sales transaction, then the data may be stored, initially in the RAM 32, in any one of a number of different desired formats. For example, an illustrative process and format for storing a retail sales transaction is set forth within the dotted lines of FIG. 8. As depicted, a "COMPUTE KEY" subroutine constructs a "key" or identification code for the retail sales transaction. The key may be composed of the Universal Product Code corresponding to the scanned retail item appended with the unit price at which the retail item was sold. Subsequently, a "SEARCH TABLE FOR KEY" subroutine is performed in which a data table in the RAM 32 is searched to determine if the key constructed during the previous subroutine exists in the RAM 32. The data table in the RAM 32 contains keys previously constructed in accordance with the above-mentioned "COMPUTE KEY" subroutine. The data table is arranged in a conventional, well known binary tree structure that enables extremely rapid searches through the data table which may contain over 30,000 different keys corresponding to 30,000 different UPC/unit price combinations.

If the key is located in the data table, an "INCREMENT COUNT" subroutine is performed in which the quantity sold field in the RAM 32 associated with that key is incremented by the amount of the quantity sold field in the transaction being processed. Thereafter, the program returns to the "SNAP?" subroutine.

Alternatively, if the Key for the transaction being processed was not located in the data table in the RAM 32, an "INSERT TRANSACTION IN TABLE" subroutine is executed by which the computed key for the transaction is inserted in the appropriate place in the data table in the RAM 32 and the quantity sold field in

-36-

the RAM 32 for that key is set to the amount of the quantity sold field in the transaction. The program then returns to the "SNAP?" subroutine.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. For example, retail sales transactions determined to be complete, as discussed hereinabove, may be formatted and stored initially in the RAM 32 and subsequently in the DASD 34 in many different desired formats. Importantly, complete retail sales transactions may be organized for use in "market basket" analyses by grouping together retail sales transactions corresponding to all of the purchases made by each customer during a single trip through the check-out line in the retail store. All retail sales transactions occurring prior to the determination of the total amount owed by a customer for the purchase of the retail items presented to a checker during a trip through a check-out line in the retail store can be grouped together by the CPU 30 and the RAM 32 for subsequent transfer to the DASD 34 in the in-store device 12. From this information, an average "market basket" in the form of the types or quantities of retail items purchased or in the form of the cost of the items purchased can be determined for each retail store or, if desired, for a designated group of retail stores in the market research system 10. Alternatively, a unique identification code either scanned or keyed into the scanner/register 18 can be used as a key to identify a "market basket", i.e., the items purchased and their cost, of each cooperating panelist in the market research system 10.

Furthermore, the operation of the in-store device 12 including the formatting and storing of complete retail sales transactions by the in-store device 12 may be updated or modified during a communications session between the in-store device 12 and

the remotely located central site 24. The market
research system 10 is highly flexible in that the
market research test area, i.e., the area in which
the cooperating retail stores of the system 10 are
5 located, may be selected as desired. For example,
the market research test area may involve a single
geographic locality, such as a city, county or state,
or a single geographic region, such as a portion of a
country, or an entire country, such as the United
10 States of America, or even several countries, such as
the United States of America and Canada. Thus, it is
to be understood that, within the scope of the appended
claims, the invention may be practiced otherwise than
as specifically described hereinabove.

15 What is claimed and is desired to be secured
by Letters Patent is:

20

25

30

35

-38-

1. A market research system comprising
a plurality of cooperating retail stores in
a market research test area, each of said stores having
at least partially automated first means for processing
retail sales transactions in said store,

non-invasive automated second means disposed
in each of said stores for monitoring said first means
in a substantially totally passive manner and for
collecting market research data based on said retail
sales transactions,

said first means operating independently of
said second means, and

automated third means remotely located from
said plurality of retail stores for receiving said
market research data from said plurality of retail
stores and for storing said market research data for
subsequent use by market researchers.

2. A market research system as recited in
claim 1 wherein said second means includes sensor
means for monitoring said first means, said sensor
means including an antenna.

3. A market research system as recited in
claim 2 wherein said first means generates first elec-
trical signals relating to said retail sales transac-
tions and wherein said antenna is physically disposed
in the vicinity of said first means for enabling at
least portions of said first electrical signals to be
detected by said antenna.

4. A market research system as recited in
claim 3 wherein the only electrical signal connection
between said first means and said second means is
through said antenna.

5. A market research system as recited in claim 3 wherein said second means further includes microprocessor means for processing and storing retail sales transaction data detected by said antenna, said microprocessor means being otherwise adapted to process and store said retail sales transaction data independently of said first means.

6. A market research system as recited in claim 5 wherein said microprocessor includes a central processing unit, variable memory means and retail sales transaction data storage means.

7. A market research system as recited in claim 6 wherein said second means further includes adapter means for adapting said second means to a particular first means in said store in which said second means is disposed for enabling said microprocessor to process said retail sales transaction data detected by said antenna.

8. A market research system as recited in claim 7 wherein said second means further comprises interface means disposed between said sensor means and said adapter means for supplying electrical power to said sensor means and for supplying second electrical signals representative of said first electrical signals to said adapter means.

9. A market research system as recited in claim 8 wherein said electrical power and said second electrical signals are transmitted simultaneously between said sensor means and said interface means over the same electrical conductors.

10. A market research system as recited in claim 9 wherein said sensor means includes high pass

-40-

filter means for suppressing spurious signals and impedance matching means for interconnecting said antenna and said high pass filter means.

11. A market research system as recited in claim 10 wherein at least one of said high pass filter means and said impedance matching means comprises an operational amplifier that is powered by said electrical power from said interface means.

12. A market research system as recited in claim 11 wherein both of said high pass filter means and said impedance matching means comprise operational amplifiers that are powered by said electrical power from said interface means.

13. A market research system as recited in claim 7 wherein said interface means comprises power supply means for supplying low voltage direct current power to said sensor means and amplifying means for amplifying at least portions of time varying signals received from said sensing means.

14. A market research system as recited in claim 13 wherein said interface means further comprises means for suppressing spurious time varying signals and for increasing the rise times of non-spurious time varying signals.

15. A market research system as recited in claim 14 wherein said suppressing means comprises at least one Schmitt Trigger device.

16. A market research system as recited in claim 13 wherein said interface means further comprises line-driver means for providing a digital logic signal

of a required amplitude from said interface means to said adapter means.

17. A market research system as recited in claim 6 wherein said second means further comprises communications modem means for enabling said second means to transfer said market research data to said third means.

18. A market research system as recited in claim 3 wherein said third means further comprises means for remotely reprogramming said microprocessor.

19. A market research system as recited in claim 1 further comprising means for transferring said market research data from said second means to said third means.

20. A market research system as recited in claim 19 wherein said transferring means comprises a telephone connection between said second means and said third means.

21. A market research system as recited in claim 20 wherein said telephone connection comprises a switched line telephone connection.

22. A market research system as recited in claim 19 wherein said transferring means includes a packet-switched data communications network for inter-connecting said second means in said plurality of retail stores and said third means.

23. A market research system as recited in claim 19 wherein said transferring means comprises a radio frequency modem disposed in at least one of

-42-

said plurality of retail stores for transferring market research data over-the-air from said second means.

24. A market research system as recited in claim 19 wherein said transferring means comprises a data communications network for transferring said market research data from said second means to said third means via an earth orbiting satellite.

25. A market research system as recited in claim 1 wherein said third means comprises automated central processing means for processing said market research data and data storage means for storing said market research data.

26. A market research system as recited in claim 1 wherein said market research test area comprises an entire country.

27. A market research system as recited in claim 1 wherein said first means comprises at least one optical UPC scanner and an automated scanner controller, said scanner and said controller being interconnected by a digital data store communications loop.

28. A market research system as recited in claim 27 wherein said second means includes sensor means for monitoring said store loop, said sensor means including antenna means for detecting digital data present on said store loop representative of said retail sales transactions.

29. A market research system as recited in claim 28 wherein the only electrical signal connection between said first means and said second means is through said antenna means.

30. A market research system as recited in claim 29 wherein said second means further includes microprocessor means for processing said digital data detected by said antenna means, said microprocessor means being otherwise adapted to collect said retail sales transaction data represented by said digital data independently of said first means.

31. A market research data collection system comprising

a plurality of cooperating retail stores, each store of said plurality of stores having automated first means for processing retail sales transactions in said store,

automated second means disposed in each of said stores for monitoring said first means in a substantially totally passive manner and for collecting market research data based on said retail sales transactions with respect to different types of retail sales items, said second means otherwise operating independently of said first means,

said first means operating independently of said second means,

third means remotely located from said plurality of retail stores for receiving said market research data from said second means and for storing said market research data for subsequent use and

means for transferring said market research data from said second means to said third means.

32. A market research data collection system as recited in claim 31 wherein said first means comprises at least one optical UPC scanner and an automated scanner controller, said scanner and said controller being interconnected by a digital data store communications loop.

-44-

33. A market research data collection system as recited in claim 32 wherein said second means includes antenna means for detecting digital data present on said store loop representative of said retail sales transactions.

34. A market research data collection system as recited in claim 33 wherein the only electrical signal connection between said first means and said second means is through said antenna means.

35. A market research data collection system as recited in claim 34 wherein said second means further includes microprocessor means for processing said digital data detected by said antenna means, said microprocessor means being otherwise adapted to collect said retail sales transaction data represented by said digital data independently of said first means.

36. A market research data collection system comprising

a plurality of cooperating retail stores, each of said stores having automated first means for processing retail sales transactions in said store, said first means comprising at least one point-of-sale scanner and an automated scanner controller, said scanner and said controller being interconnected by a digital data store communications loop,

non-invasive automated second means disposed in each of said stores for monitoring said store loop in a substantially totally passive manner and for collecting market research data based on said retail sales transactions, said second means including antenna means for detecting digital data present on said store loop representative of said retail sales transactions, and

third means remotely located from said plurality of retail stores for receiving said market research data from said plurality of retail stores and for storing said market research data.

37. A market research data collection system as recited in claim 36 wherein said antenna means is physically disposed adjacent to a portion of said store loop for enabling said antenna means to detect said digital data present on said store loop.

38. A market research data collection system as recited in claim 37 wherein the only electrical signal connection between said first means and said second means is through said antenna means.

39. A market research data collection system as recited in claim 38 wherein said second means further includes microprocessor means for processing said digital data detected by said antenna means, said microprocessor means being otherwise adapted to collect said retail sales transaction data represented by said digital data independently of said first means.

40. A market research data collection system as recited in claim 39 wherein said microprocessor means includes a central processing unit, variable memory means and retail sales transaction data storage means.

41. A market research data collection system as recited in claim 40 wherein said second means further includes adapter means for adapting said second means to a particular first means in said store in which said second means is disposed for enabling said microprocessor to process said digital data detected by said antenna means.

-46-

42. A market research data collection system as recited in claim 41 wherein said antenna means comprises part of a sensor assembly disposed adjacent to said portion of said store loop for monitoring said digital data present on said store loop and wherein said second means further comprises interface means disposed between said sensor assembly and said adapter means for supplying low voltage, direct current electrical power to said sensor assembly and for supplying time varying electrical signals representative of said digital data detected by said antenna means to said adapter means.

43. A market research data collection system as recited in claim 42 wherein said electrical power and said electrical signals are transmitted simultaneously between said sensor assembly and said interface means over the same electrical conductors.

44. A market research data collection system as recited in claim 36 further comprising fourth means for transferring said market research data from said second means to said third means.

45. A market research data collection system as recited in claim 44 wherein said fourth means comprises a switched line telephone connection between said second means and said third means.

46. A market research data collection system as recited in claim 44 wherein said fourth means includes a packet-switched data communications network for interconnecting said second means and said third means.

47. A market research data collection system as recited in claim 44 wherein said fourth means com-

prises a radio frequency modem disposed in each of said stores for transferring market research data over-the-air from said stores.

48. A market research data collection system as recited in claim 44 wherein said fourth means comprises a data communications network for transferring said market research data from said second means to said third means via an earth orbiting satellite in a geostationary orbit above the earth.

49. A market research data collection system as recited in claim 36 wherein said third means comprises automated central processing means for processing said market research data and data storage means for storing said market research data after processing by said automated central processing means.

50. A retail store data collection system for use in a retail store having at least one Point-Of-Sale scanner and a scanner controller interconnected by a store data communications loop comprising

antenna means disposed in the vicinity of a portion of said store loop for detecting data signals present on said store loop and

memory means for storing information in response to the detection of said data signals by said antenna means.

51. A retail store data collection system as recited in claim 50 wherein said data signals present on said store loop comprises digital data signals.

52. A retail store data collection system as recited in claim 51 wherein the only electrical signal connection between said scanner and said scanner controller and said store loop on the one hand and

-48-

said data collection system on the other hand is through said antenna means.

53. A retail store data collection system as recited in claim 52 further comprising microprocessor means for processing said digital data signals detected by said antenna means, said microprocessor means being otherwise adapted to process said digital data independently of said scanner and of said scanner controller.

54. A method of collecting market research data from a plurality of cooperating retail stores, each store of said plurality of stores having at least one Point-Of-Sale scanner and a scanner controller and a store digital data communications loop interconnecting said scanner and said scanner controller, said method comprising the steps of

disposing non-invasive means in each of said stores for monitoring in a substantially totally passive manner with respect to said scanner and said scanner controller and said store loop digital data present on said store loop representative of retail sales transactions in said store,

detecting said digital data present in said store loop,

storing information in response to the detection of said digital data in a memory separate from the automated equipment in said store responsible for the normal retail sales operations of said retail store and

transmitting said information from said retail store to a remote central location for processing, storage and subsequent use by market researchers.

55. A method of collecting market research data from a plurality of cooperating retail stores,

each store of said plurality of stores having automated equipment interconnected by a store digital data communications loop for handling retail sales transactions in said store and for controlling the normal retail sales operations of said store, said method comprising the steps of

detecting digital data present on said store loop representative of said retail sales transactions by means of an antenna and

storing information relating to said retail sales transactions in response to the detection of said digital data by said antenna in a memory separate from and independent of said automated equipment in said store.

56. A method of collecting market research data from a plurality of cooperating retail stores as recited in claim 55 further comprising the step of periodically transmitting said information from said retail store to a remote location for subsequent use by market researchers.

57. A method of collecting market research data concerning retail sales transactions occurring in each store of a plurality of cooperating retail stores comprising the steps of

detecting in a substantially totally passive manner electrical data signals present in said store representative of said retail sales transactions and

storing information in response to the detection of said electrical data signals in a memory in said store separate from the equipment in said store responsible for handling said retail sales transactions and the normal operations of said store and

periodically sending said information stored in said memory from said store to a remote location for subsequent use by market researchers.

-50-

58. A method of collecting market research data as recited in claim 57 wherein said detecting step includes the step of disposing antenna means in said store for detecting said electrical data signals present in said store.

59. A method of collecting market research data as recited in claim 58 further comprising the step of providing microprocessor means in said store separate from said equipment in said store for processing said electrical data signals detected by said antenna means and for otherwise operating independently of said equipment in said store.

60. A method of collecting market research data as recited in claim 57 wherein said sending step includes the step of utilizing a switched-line telephone connection between said store and said remote location for sending said information from said store to said remote location.

61. A method of collecting market research data as recited in claim 57 wherein said sending step includes the step of utilizing a packet-switched data communications network between said store and said remote location for sending said information from said store to said remote location.

62. A method of collecting market research data as recited in claim 57 wherein said sending step includes the step of utilizing an earth orbiting satellite communications link between said store and said remote location for sending said information from said store to said remote location.

63. A method of collecting retail sales transaction data in a retail store having at least

one Point-Of-Sale optical scanner and a scanner controller interconnected by a store digital data communications loop comprising the steps of

disposing antenna means in the vicinity of a portion of said store loop for detecting digital data on said store loop representative of retail sales transactions in said store and

storing information in response to the detection by said antenna means of said digital data representative of said retail sales transactions in a memory separate from the equipment in said store responsible for processing said retail sales transactions and for controlling the normal operations of said store.

64. A method of collecting retail sales transaction data in a retail store as recited in claim 63 further comprising the step of providing a micro-processor in said store separate from and operating independently of said equipment in said store for processing said digital data detected by said antenna means to obtain said information for storage in said memory.

65. A method of collecting retail sales transaction data in a retail store as recited in claim 64 further comprising the step of periodically transferring said information from said memory to a remote location for further processing, storage and use by market researchers.

66. A method of collecting retail sales transaction data in a retail store as recited in claim 65 wherein said transferring step includes the step of utilizing a switched-line telephone connection in transferring said information from said memory to said remote location.

-52-

67. A method of collecting retail sales transaction data in a retail store as recited in claim 65 wherein said transferring step includes the step of utilizing a packet-switched data communications network in transferring said information from said memory to said remote location.

68. A method of collecting retail sales transaction data in a retail store as recited in claim 65 wherein said transferring step includes the step of utilizing a microwave communications link including an earth-orbiting satellite in a geostationary orbit above the earth in transferring said information from said memory to said remote location.

69. A market research data collection system comprising

a plurality of cooperating retail stores, each store of said plurality of stores having automated first means for processing retail sales transactions in said store, said first means comprising at least one Point-Of-Sale optical scanner and an automated scanner controller and a digital data store communications loop interconnecting said scanner and said controller,

non-invasive automated second means disposed in each store of said plurality of stores for monitoring said store loop and for collecting information based on said retail sales transactions useful in performing "market basket" analyses, said second means including means for detecting digital data present on said store loop representative of said retail sales transactions and otherwise operating independently of said scanner and said scanner controller and said store loop and

third means remotely located from said plurality of retail stores for receiving said

information from said second means for further processing, storage and subsequent use by market researchers in performing "market basket" analyses.

Fig. 1

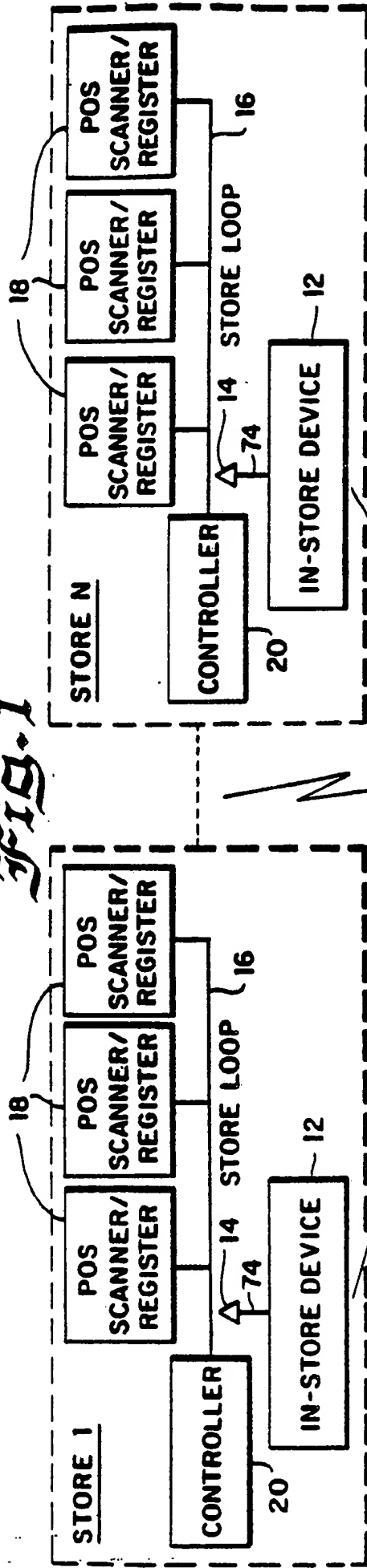


Fig. 2

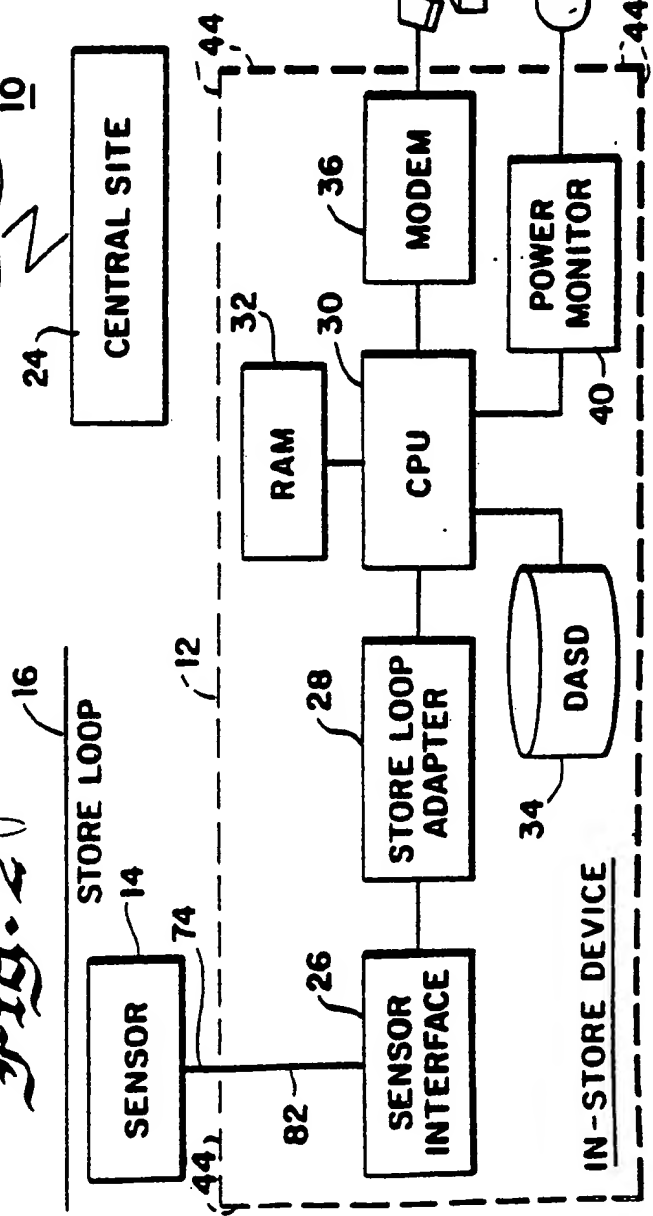
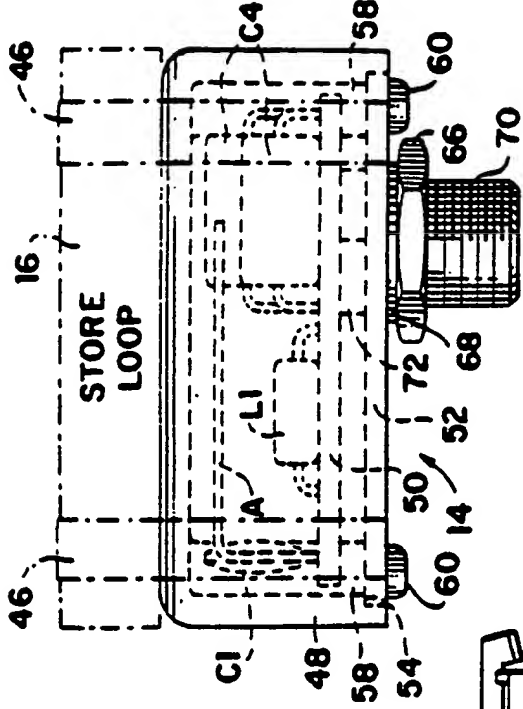
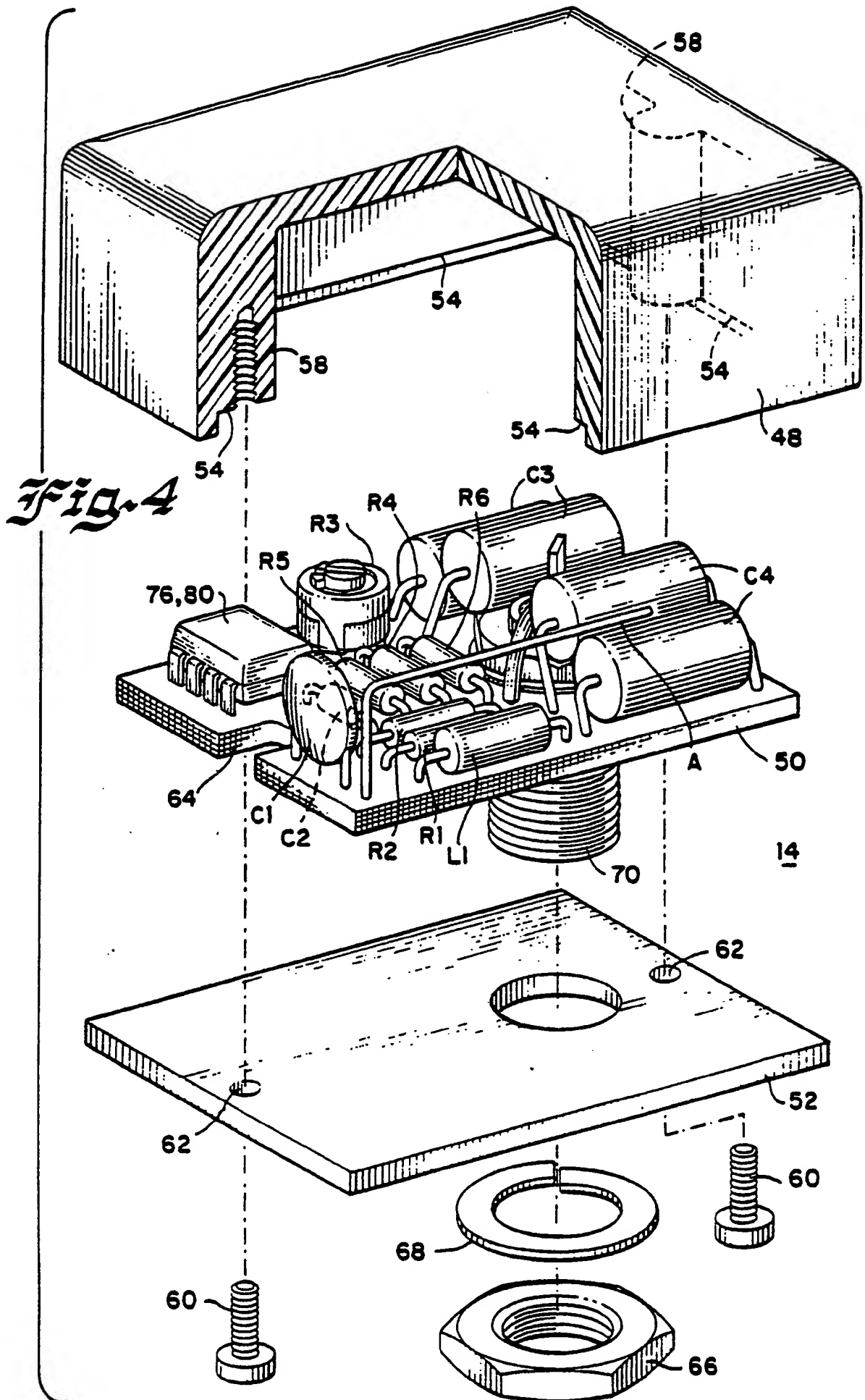


Fig. 3





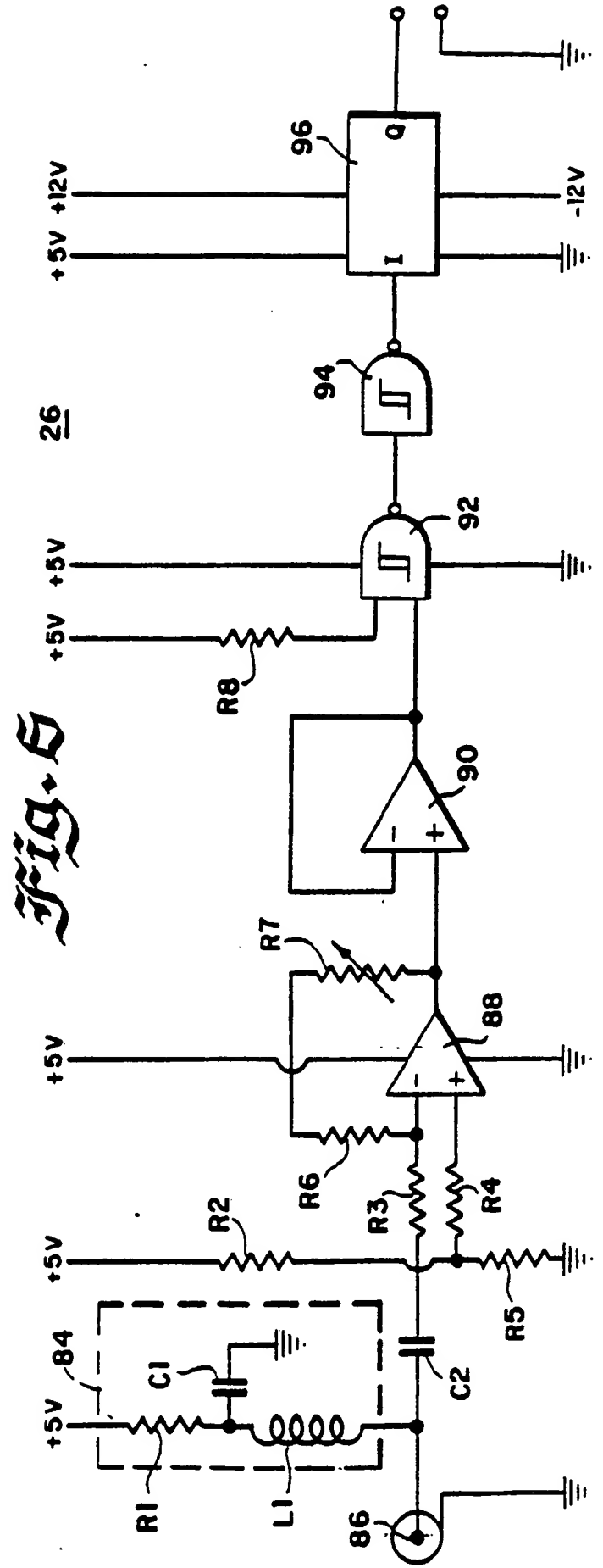
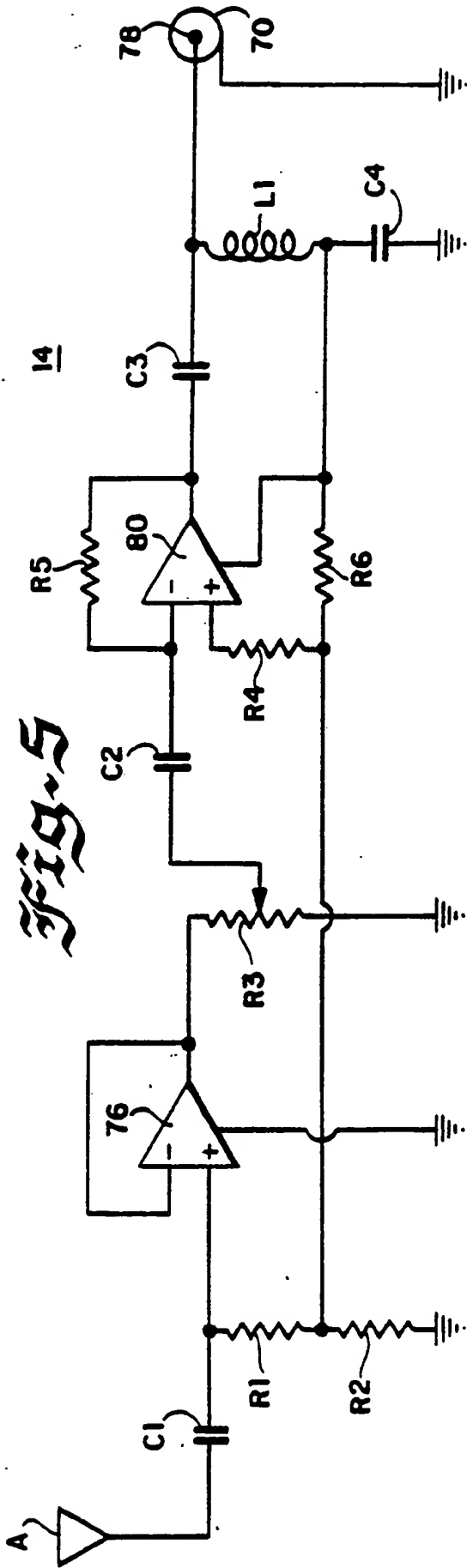


Fig. 5

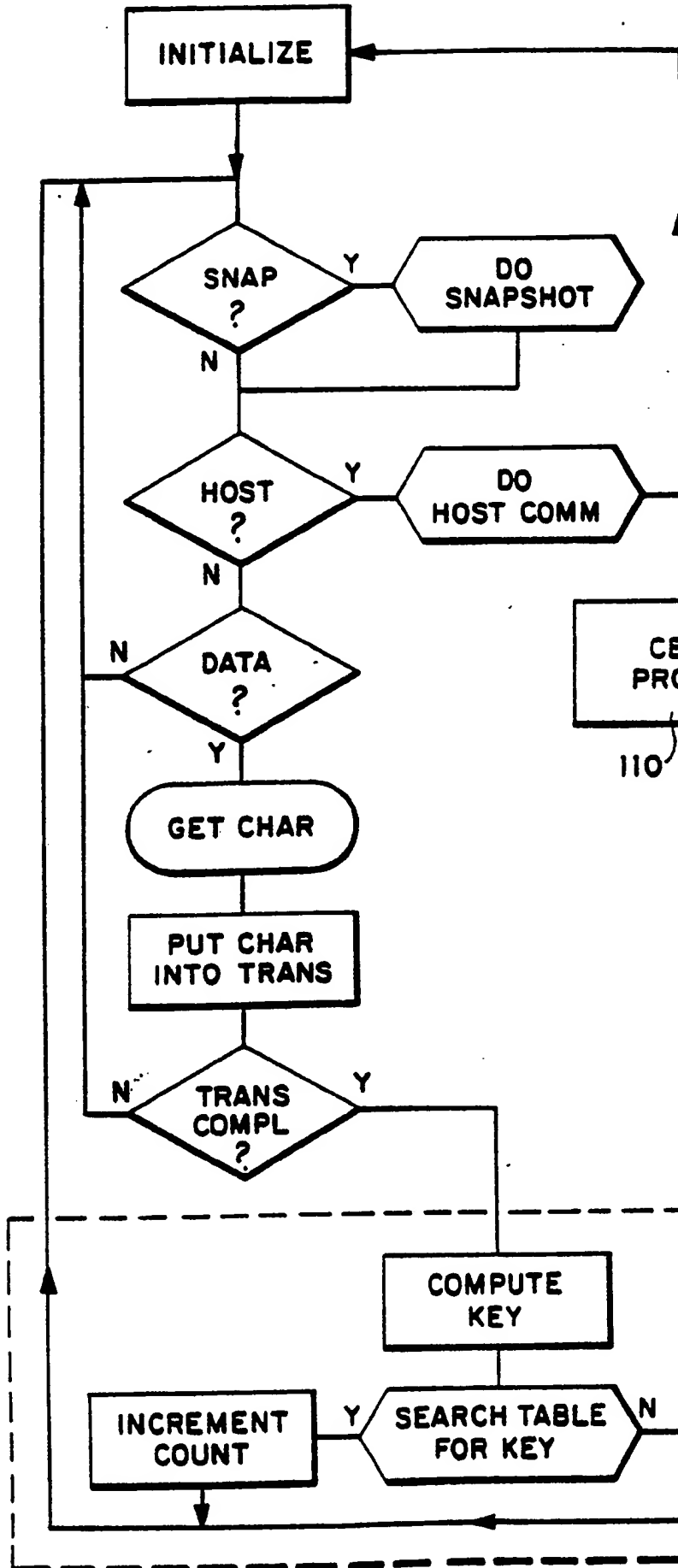
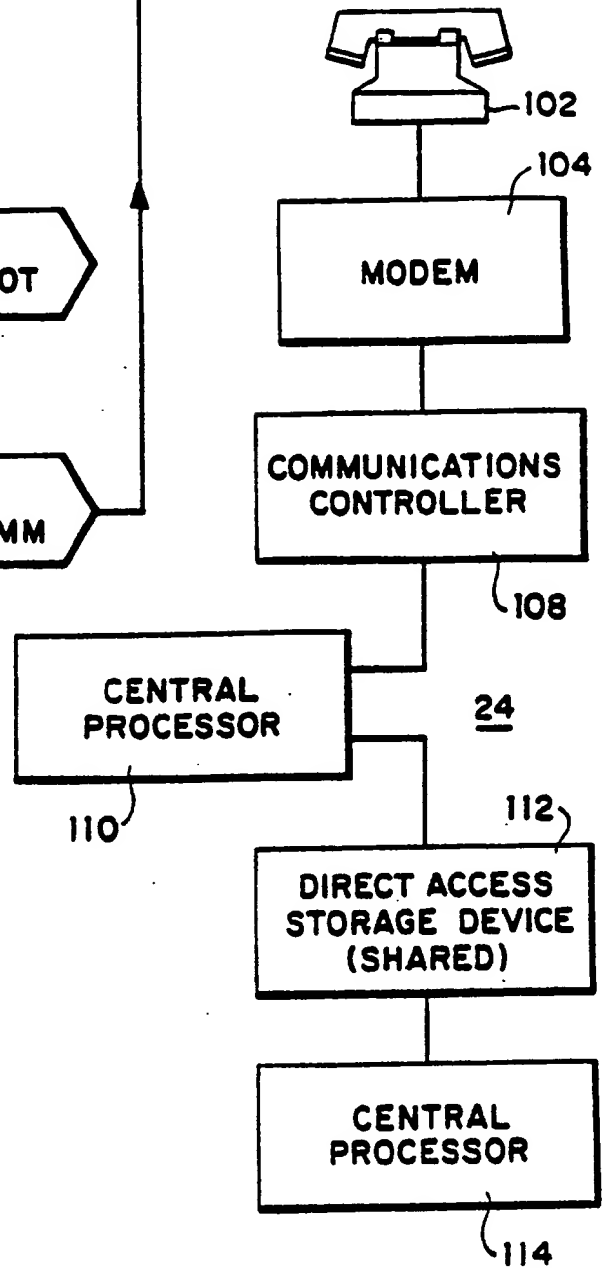


Fig. 7



INTERNATIONAL SEARCH REPORT

International Application No. PCT/US89/00385

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC <div style="text-align: center; margin-top: 5px;"> INT. CL.⁴ H04B 17/00 U.S. CL. 455/2 </div>																										
II. FIELDS SEARCHED <div style="text-align: center; margin-top: 5px;"> Minimum Documentation Searched ⁷ </div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <th style="width: 20%;">Classification System</th> <th style="width: 80%;">Classification Symbols</th> </tr> <tr> <td style="text-align: center; vertical-align: top;">U.S.</td> <td> 455/2, 41 379/92, 55 358/84 333/24c, 254, 255, 260 235/380, 381, 383, 385 364/225, 226.3, 401, 402, 403, 404, 918, 918.1, 918.4, 918.5 </td> </tr> </table> <div style="text-align: center; margin-top: 5px;"> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸ </div>			Classification System	Classification Symbols	U.S.	455/2, 41 379/92, 55 358/84 333/24c, 254, 255, 260 235/380, 381, 383, 385 364/225, 226.3, 401, 402, 403, 404, 918, 918.1, 918.4, 918.5																				
Classification System	Classification Symbols																									
U.S.	455/2, 41 379/92, 55 358/84 333/24c, 254, 255, 260 235/380, 381, 383, 385 364/225, 226.3, 401, 402, 403, 404, 918, 918.1, 918.4, 918.5																									
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%;">Category *</th> <th style="width: 60%;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A 4,355,372 (Johnson et al.) 19 October 1982. See Figs. 1, 13, 14, column 2, lines 20 to 28 and lines 55 to 63, column 3, lines 4 to 11 and column 4, lines 3 to 50.</td> <td style="vertical-align: top;">1 to 7, 19 to 41 and 44 to 69</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>US, A, 4,331,973 (Eskin et al.) 25 May 1982. See Figs. 1, 7, column 3, line 56, to column 4, line 26, and column 14, line 25, to column 15, line 27.</td> <td style="vertical-align: top;">1 to 7, 19 to 41 and 44 to 69</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">Y</td> <td>The Ethernet Sourcebook, 1985. Robyn E. Shotwell et al., "NT 100 Ethernet/IEEE-802.3 Transceiver Unit" page 292. See all of page 292.</td> <td style="vertical-align: top;">2 to 7, 28 to 30, 33 to 41, 44 to 53, 55, 56, 58, 59 and 63 to 69</td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>US, A 4,141,078 (Bridges, Jr., et al.) 20 February 1979.</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>US, A, 4,153,931 (Green et al.) 08 May, 1979.</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>US, A, 4,546,382 (McKenna et al.) 08 October 1985.</td> <td></td> </tr> <tr> <td style="text-align: center; vertical-align: top;">A</td> <td>US, A, 4,630,108 (Gomersall) 16 December 1986.</td> <td></td> </tr> </table> <div style="text-align: right; margin-top: 5px;">(continued)</div>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	Y	US, A 4,355,372 (Johnson et al.) 19 October 1982. See Figs. 1, 13, 14, column 2, lines 20 to 28 and lines 55 to 63, column 3, lines 4 to 11 and column 4, lines 3 to 50.	1 to 7, 19 to 41 and 44 to 69	Y	US, A, 4,331,973 (Eskin et al.) 25 May 1982. See Figs. 1, 7, column 3, line 56, to column 4, line 26, and column 14, line 25, to column 15, line 27.	1 to 7, 19 to 41 and 44 to 69	Y	The Ethernet Sourcebook, 1985. Robyn E. Shotwell et al., "NT 100 Ethernet/IEEE-802.3 Transceiver Unit" page 292. See all of page 292.	2 to 7, 28 to 30, 33 to 41, 44 to 53, 55, 56, 58, 59 and 63 to 69	A	US, A 4,141,078 (Bridges, Jr., et al.) 20 February 1979.		A	US, A, 4,153,931 (Green et al.) 08 May, 1979.		A	US, A, 4,546,382 (McKenna et al.) 08 October 1985.		A	US, A, 4,630,108 (Gomersall) 16 December 1986.	
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³																								
Y	US, A 4,355,372 (Johnson et al.) 19 October 1982. See Figs. 1, 13, 14, column 2, lines 20 to 28 and lines 55 to 63, column 3, lines 4 to 11 and column 4, lines 3 to 50.	1 to 7, 19 to 41 and 44 to 69																								
Y	US, A, 4,331,973 (Eskin et al.) 25 May 1982. See Figs. 1, 7, column 3, line 56, to column 4, line 26, and column 14, line 25, to column 15, line 27.	1 to 7, 19 to 41 and 44 to 69																								
Y	The Ethernet Sourcebook, 1985. Robyn E. Shotwell et al., "NT 100 Ethernet/IEEE-802.3 Transceiver Unit" page 292. See all of page 292.	2 to 7, 28 to 30, 33 to 41, 44 to 53, 55, 56, 58, 59 and 63 to 69																								
A	US, A 4,141,078 (Bridges, Jr., et al.) 20 February 1979.																									
A	US, A, 4,153,931 (Green et al.) 08 May, 1979.																									
A	US, A, 4,546,382 (McKenna et al.) 08 October 1985.																									
A	US, A, 4,630,108 (Gomersall) 16 December 1986.																									
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>																										
IV. CERTIFICATION <table style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">29 March 1989</div> </td> <td style="width: 50%; vertical-align: top;"> Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">12 JUN 1989</div> </td> </tr> <tr> <td style="vertical-align: top;"> International Searching Authority <div style="text-align: center; margin-top: 10px;">ISA/US</div> </td> <td style="vertical-align: top;"> Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> Ralph E. Smith </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">29 March 1989</div>	Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">12 JUN 1989</div>	International Searching Authority <div style="text-align: center; margin-top: 10px;">ISA/US</div>	Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> Ralph E. Smith </div>																				
Date of the Actual Completion of the International Search <div style="text-align: center; margin-top: 10px;">29 March 1989</div>	Date of Mailing of this International Search Report <div style="text-align: center; margin-top: 10px;">12 JUN 1989</div>																									
International Searching Authority <div style="text-align: center; margin-top: 10px;">ISA/US</div>	Signature of Authorized Officer <div style="text-align: center; margin-top: 10px;"> Ralph E. Smith </div>																									

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	US, A 4,636,950 (Caswell et al.) 13 January 1987.	
A	US, A, 4,677,552 (Sibley, Jr.) 30 June 1987	

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☒ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☒ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☒ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.